

V. *On Insects and Insectivorous Birds ; and especially on the Relation between the Colour and the Edibility of Lepidoptera and their Larvæ.* By J. JENNER WEIR, F.L.S.

[Read 1st March, 1869.]

DURING the past Summer I made several experiments, as suggested by Mr. Alfred R. Wallace, with a view to ascertain what species of Insects are eaten by Birds ; and, on the contrary, what species are rejected.

Although the observations I am about to detail have only recently been made for a special object, yet my knowledge of the relations which exist in many cases between birds and insects extends over a period of more than thirty years.

The difficulty of keeping alive purely insectivorous birds in captivity is so great, that I have been obliged to restrict myself to those whose food is of a mixed character, and which thrive in confinement.

I have, therefore, relied mainly on the following species, viz. :—

The Robin, *Erithaca rubecula*.

„ Yellow-hammer, *Emberiza citrinella*.

„ Reed Bunting, *Emberiza schæniclus*.

„ Bullfinch, *Pyrrhula vulgaris*.

„ Chaffinch, *Fringilla cælebs*.

„ Crossbill, *Loxia curvirostra*.

„ Thrush, *Turdus musicus*.

„ Tree Pipit, *Anthus arboreus*.

And in a less degree, on

The Siskin, *Carduelis spinus*.

And The Redpoll, *Linaria minor*.

Within the limits of the order *Lepidoptera*, the following results have been obtained.

The apterous female of *Orgyia antiqua* is the only Lepidopterous insect I have found to be entirely rejected in the perfect state ; this I distinctly saw refused, after examination, by both the Robin and Reed Bunting, and it was quite disregarded by the other species:

The imago of *Spilosoma menthastri* was refused by the Bullfinch and Chaffinch; picked up by the Yellow-hammer, but dropped; tasted by the Reed Bunting, but not relished, and soon dropped; the latter bird, however, attracted by the fluttering insect, returned to it, and ultimately swallowed it. *Spilosoma menthastri* was also eaten by the Robin. I had been led to expect that this insect would be refused by all the birds; it was certainly not eaten with avidity, but on the contrary, after much hesitation.

All perfect *Lepidoptera* apparently require preparation before they are swallowed by birds; they are taken between the mandibles, shaken and bruised for a minute or two, and generally have the wings removed before they are eaten. This often affords a strong moth a good chance of escape, and such day-flying species as the genus *Triphaena*, which jump about in a jerking manner, and soon conceal themselves amongst the herbage, would, in a state of nature, almost always slip away from their tormentors. I have, even on the floor of my aviary, seen the struggle between the bird and the insect prolonged for several minutes. *Triphaena pronuba* is very slippery, and the flight is but little impeded by the partial destruction of the under-wings, which by their yellow colour attract the bird's attention, and are, therefore first attacked, and, perhaps, mutilated; so that the difficulty of its capture compensates for its greater liability to pursuit, owing to its diurnal habits.

Other brightly-coloured day-flying *Heterocera*, such as *Anthrocera filipendulae*, which in no way attempts concealment, and is of sluggish habits, were unwillingly eaten, but I am by no means inclined to attach undue importance to this fact, because the birds, being in confinement, and deprived mainly of their usual insect food, might readily be expected to eat insects, which, in a state of nature, with a less limited choice, they would reject.

It is characteristic of many genera of day-flying *Lepidoptera Heterocera*, that they have brightly-coloured, and more or less ornamented under-wings, and very dull gray or brown upper-wings, quite concealing the former when at rest; these under-wings are of various colours, for instance, silvery in *Agrotis*; yellow in *Triphaena*, *Anarta*, and other genera; crimson, red, or blue in *Catocala* and *Callimorpha*.

I feel quite satisfied from actual experiment, that this distribution of colour is a great advantage to these diurnal species in the struggle for existence.

As before remarked, the bird seizes the most conspicuous part, which is very fragile ; thus giving the insect another chance of escape, with a small notch only out of the under-wing. I once saw *Triphaena fimbria* in broad daylight rise to a great height, pursued by a swallow, which made several ineffectual attempts to seize it, and it certainly effected its escape ; the swallow giving up the pursuit, completely baffled.

I have also seen a moth, *Macaria notata*, fly very fairly with only the two fore-wings developed, not, perhaps, quick enough to avoid such a swift bird as the swallow, but sufficiently to enable this wood-haunting species to reach a thicket in safety.

The sudden manner in which the brilliantly coloured under-wings are displayed, is another great advantage to the insect ; the bird is startled, and draws back ; and before it recovers its surprise, the prey escapes.

The flight of the *Triphaenæ*, and their mode of unexpectedly rising from, and quickly dropping into, the herbage, and concealing themselves, is exactly the same as that of some species of European grasshoppers belonging to the genus *Ædipoda*, which also display bright crimson or blue under-wings, combined with earthy coloured upper-wings ; and I have no doubt are benefited in the same manner by a similar distribution of colours.

The results obtained with the larvæ and pupæ of *Lepidoptera* were of a more decisive and satisfactory character.

I found that all hairy caterpillars were uniformly uneaten. The species experimented with were *Arctia caca*, *Eriogaster lanestris*, *Porthesia auriflua*, and *Orgyia antiqua* ; none of these species were even examined by the birds, and were permitted to crawl about the aviary for days with impunity.

I am disposed to consider that the flavour of all these larvæ is nauseous, and not that the mechanical troublesomeness of the hairs prevents their being eaten.

In order to throw some light on this point, I made an experiment with *Spilosoma menthastri* ; this species in the larval state is always rejected, but being fortunate

enough to obtain about one hundred young larvæ a few hours old, having indeed only just emerged from the egg, I introduced them into the aviary on their natal leaf. The movement of the little creatures soon attracted the notice of a Siskin; the bird tasted one of the minute caterpillars, shook its beak as if it were disagreeable, and left the rest undisturbed; a Redpoll followed, but the result was the same. A West-African insectivorous Finch, *Teutor erythrorhynchus*, next tried their flavour, but soon left them, evidently not liking it. No further molestation took place, and the minute larvæ remained undisturbed.

I cannot think that, in this case, the rejection arose from the hairiness of the larvæ. I imagine that it was caused by their disagreeable flavour, and that the birds were deceived into tasting them, because the characteristic warning hairs were undeveloped; and that, on the other hand, when the caterpillars are more developed, the hairs serve as a caution to the birds, that the larvæ so clothed are uneatable.

The results obtained with spined larvæ were very similar, and the deductions I make are the same. The larvæ experimented on were those of *Vanessa urticae*, and *Vanessa Io*; these species both, as is well known, feed on the tops of *Urtica dioica*, without any attempt at concealment; the larvæ were utterly disregarded by all the birds, and were allowed to crawl about the aviary for days. The metallic looking chrysalides of the two species were also invariably rejected, thus showing that the spines were not the cause of the uneatableness of the larvæ.

Larvæ which spin webs, and are gregarious, are eaten by birds, but not with avidity; they appear very much to dislike the web sticking to their beaks, and those completely concealed in the web are left unmolested. When branches covered with the web of *Hyponomeuta crocynmella* were introduced into the aviary, those larvæ only which ventured beyond the protection of the web were eaten.

The experiments I was anxious to try were those with smooth-skinned, gaily-coloured caterpillars, which never conceal themselves, but, on the contrary, appear to court observation.

My first experiment was with the larvæ of *Abraaxas grossulariata*; and in order that the birds might be fairly attracted towards them, I placed them on a shelf in the aviary amongst other eatable species. I watched the birds carefully; they soon ate up all the well-relished and dull-coloured species, but left *Abraaxas grossulariata* untouched. I quitted the aviary for some hours, but on my return, they were still crawling about unmolested.

The same result followed the experiments with *Diloba cæruleocephala*, and *Anthrocera filipendulæ*, both conspicuous species in the larval state.

I was most desirous to try the larvæ of the genus *Cucullia*, and at last succeeded in getting several of *Cucullia verbasci* of different sizes. These larvæ, as is well known, feed on the leaves of *Verbascum thapsus*, and are most beautifully coloured with bright blue, yellow, and black; and their skins are perfectly smooth. It appeared to me that experiments with this species would be conclusive; and I confess to feeling very excited when I made them. I had however the pleasure of finding that this crucial test did not fail. The larvæ were placed on the feeding shelf one afternoon. I found them there after dinner, and the next day some were still living, and quite-unmolested.

I will now add a few words on those larvæ which are eaten greedily by birds, and my remarks on the subject will be brief; it will be unnecessary to detail all the experiments made, as the results are easily generalized.

All caterpillars whose habits are nocturnal, dull-coloured, with fleshy bodies and smooth skins, are eaten with the greatest avidity.

Every species of green caterpillar is also much relished.

All *Geometræ*, whose larvæ resemble twigs as they stand out from the plant on their anal prolegs, are invariably eaten.

To sum up, I have quite satisfied myself that insectivorous birds, as a general rule, the Cuckoo, perhaps, being an exception, refuse to eat hairy larvæ, spinous larvæ, and all those whose colours are very gay, and which rarely, or only accidentally, conceal themselves.

On the other hand, they eat with great relish, all smooth-skinned larvæ of a green or dull-brown colour, which are nearly always nocturnal in their habits, or

mimic the colour or appearance of the plant they frequent.

I propose, during the coming Summer, to continue my investigations, and shall feel grateful to any of the Members who may kindly send me living insects for experiment.

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